MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2016/2017

TCS3511 THEORY OF COMPUTING/ TIC2151 THEORY OF COMPUTATION/

(All sections / Groups)

13th October 2016
2:30 pm – 4:30 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages only excluding the cover page.
2. Attempt All questions. The distribution of the marks for each question is given.
2. Please write your answers in the answer booklet provided. Please write the question number of each answer clearly.

QUESTION (1)

NOTE: Attempt any THREE out of FOUR Parts (A), (B), (C) and (D).

(A)

1. Prove the following by construction: [3 marks]

   "For any integers **a** and **b**, if **a** or **b** is even, then **ab** is even".

2. The NFAs are defined in the same way as DFAs but with two main exceptions, what are these exceptions? (explain briefly) [2 marks]

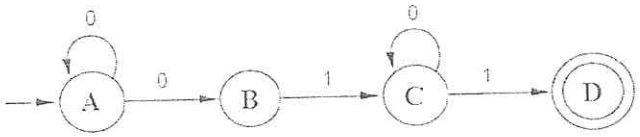
(B) Draw state diagrams for DFAs accepting each of the following languages:

L1= {w ∈ {0, 1}* | w is the set of strings that don't start with 111} [2.5 marks]

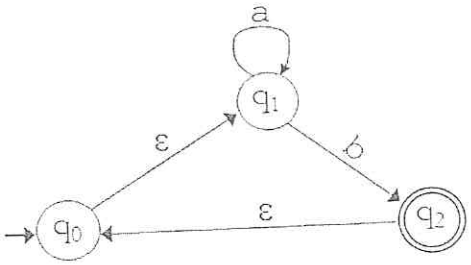
L2= {w ∈ {a, b, c}*| w = $ab^n c^m$, n,m>0 } [2.5 marks]

(C) Draw the state diagram for DFAs accepting the same languages as the following NFAs. [5 marks]

1)



2)



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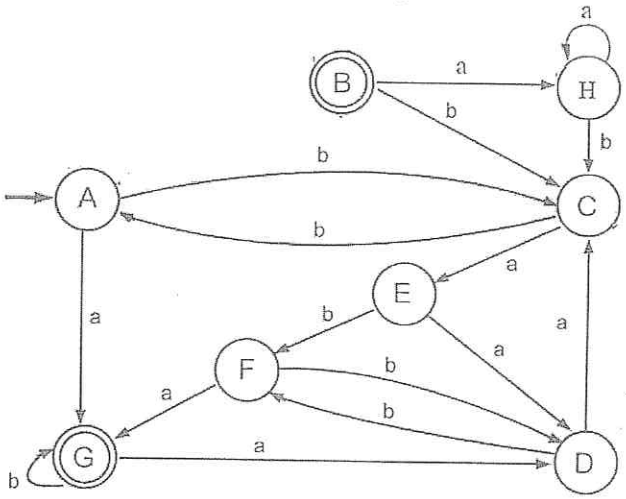
(D)

Minimize the following DFA. Show your steps. [5 marks]



QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions

   i. $(a + b)^{+}(a + b)$ [1 mark]

   ii. $00\ (0 + 1\ )^{*} + (\ 0 + 1\ )^{*}\ 00$ [1 mark]

2. Find a regular expression corresponding to each of the following languages. [3 marks]

   i. $L = \{w \in \{0, 1\}^{*} |$ w starting with 00 and ending with $11\}$
   ii. $L = \{w \in \{0, 1\}^{*} |$ the length of w is at most 2 $\}$
   iii. $L = \{w \in \{0, 1\}^{*} |$ Strings w that do not end with $11\}$

(B) Convert the following regular expression into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [5 marks]

$$(0 + 1)^{*} + (0 + 2)^{*}$$

(C)

1) Convert the following regular grammar into an NFA. [3 marks]

$S \Rightarrow a \mid bT \mid \varepsilon$
$T \Rightarrow bT \mid cQ \mid bb$
$Q \Rightarrow aaQ \mid cc \mid aT$

2) Give the regular grammars corresponding to each of the following languages over the alphabet $\{0, 1\}$.

$L_1 = \{\ w \mid w$ ends with 11 or 00 $\}$ [1 mark]
$L_2 = 0\ (101)^{*}\ 1$ [1 mark]

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QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for each of the following languages:

$L_1 = \{a^n b^{3n+1} c \mid n > 0\}$ [2.5 marks]

$L_2 = \{a^2 b^n c^n \mid n >= 1\}$ [2.5 marks]

(B)

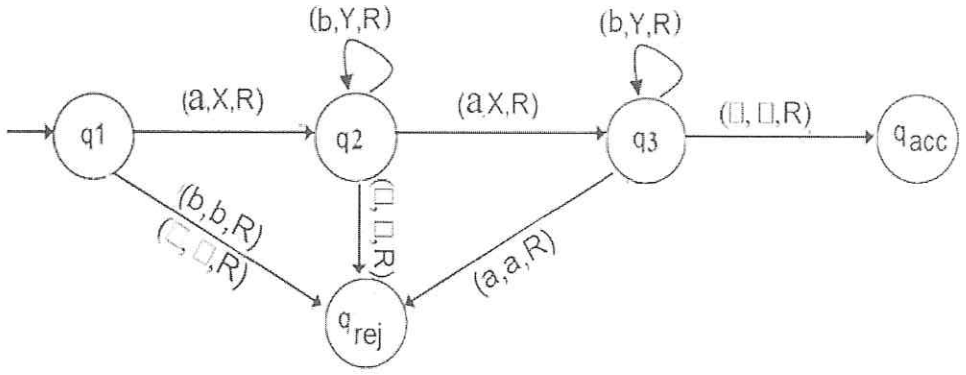
1) Convert the following context-free grammar into Chomsky Normal Form (CNF). [2.5 marks]

$$S => a \mid bSb \mid ScS$$

2) Use the Cocke-Younger-Kasami (CYK) algorithm to determine whether the words *bacabbab* can be derived from the above grammar. [2.5 marks]

QUESTION (4)

(A) Given the following Turing Machine:



1) What language does the machine accept? Give the language in regular expression form. [1.5 marks]
2) Give the formal definition of the machine. [2.5 marks]

(B) Construct a Turing Machine for the language $L = \{a^n b^n c^m \mid m, n \geq 1\}$. [4 marks]

(C) What does it mean to say that a problem is undecidable? [2 marks]

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